

Environmental changes in Lake Kawaguchi associated with the eruption of Mt. Fuji reconstructed by sedimentary biomarker analysis

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Volcanic eruptions have serious effects on the climate and surrounding environment; However, the impact of basaltic volcanic eruptions on lake environments and ecosystems remains largely unknown. In this study, we conducted biomarker analyses of lacustrine sediments at the foot of Mt. Fuji, the largest basaltic volcano in Japan, to reconstruct lake environmental changes associated with the past eruption. We used a 3.4 m-long sediment core (KG22-01), collected at a depth of 12.2 m in the western lake basin of Lake Kawaguchi, at the northern foot of Mt. Fuji. The core contains an 8 cm-thick scoria layer near the bottom of the core (depth 3.27-3.19 m), which is tentatively assigned to the Omuroyama scoria-fall deposit (Om), based on comparison with a sediment core (YA-1) collected from the nearby location. The Om is one of the largest eruptions of Mt. Fuji during the last 5.6 ka, which is ejected from the northeastern foot of Mt. Fuji at ca. 2.9 ka. Sediment samples were extracted with organic solvents and fractionated by a silica gel column before the analyses of GC-MS. The sediment contains algal biomarkers including brassicasterol, C_{32} 1, 15-diol, and C_{20} highly branched isoprenoid (HBI) alkane. The diatom-derived biomarker brassicasterol/ C_{27} sterol ratio values abruptly dropped from 0.50 to 0.39 across the Om and then increased to 11 cm above the Om. A similar trend was observed for the C_{32} 1, 15-diol/ C_{27} sterol ratio, a biomarker for green algae, suggesting a temporary (50-100 years) inhibition of biological production due to reduced transparency and leaching of toxic substances from volcanic ejecta. On the other hand, the long-term trend in the C_{32} 1, 15-diol/ C_{27} sterol ratio after the deposition of the Om showed a good agreement with that of the C_{29} sterol/ C_{27} sterol ratio of terrestrial higher plant origin, suggesting that nutrient influx from the catchment played an important role in productivity changes in Lake Kawaguchi. Another diatom-derived biomarker, C_{20} HBI/ $C_{19}+C_{21}$ alkane ratio, revealed similar long-term fluctuations to C_{32} 1, 15-diols, but showed a marked increase from the 16 cm to 26 cm above the Om with low brassicasterol/ C_{27} sterol ratios. The enhanced C_{20} HBI/ $C_{19}+C_{21}$ alkane ratios are also associated with high perylene/phenanthrene ratios, suggesting a transient lake environmental change associated with the increased influx of terrigenous material after the eruption.

Keywords: volcanic eruption, primary productivity, lake environment, Mt. Fuji, Fuji Five Lakes